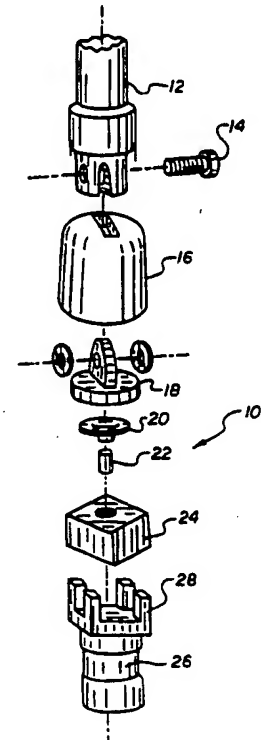




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: PCT/CA97/00155 (22) International Filing Date: 4 March 1997 (04.03.97) (30) Priority Data: 08/611,386                      5 March 1996 (05.03.96)                      US (71) Applicant: RESEARCH IN MOTION LIMITED [CA/CA]; 295 Phillip Street, Waterloo, Ontario N2L 3W8 (CA). (72) Inventors: ZHU, Lizhong; 13 High Street #1, Waterloo, Ontario N2L 3X4 (CA). QI, Yihong; Apartment 103, 982 Main Street W., Hamilton, Ontario L8S 1A8 (CA). JARMUSZEWSKI, Perry; 31 Hood Street, Guelph, Ontario N1E 5W4 (CA). EDMONSON, Peter; 138 Stone Church Road E., Hamilton, Ontario L9B 1A9 (CA). CARKNER, Steven; 504 B Lonelm Court, Waterloo, Ontario N2L 5E1 (CA). (74) Agent: PERRY, Stephen, J.; Sim & McBurney, 6th floor, 330 University Avenue, Toronto, Ontario M5G 1R7 (CA).		(81) Designated States: CA, KR, SG, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published With international search report.
(54) Title: ANTENNA FOR A RADIO TELECOMMUNICATIONS DEVICE (57) Abstract <p>A radio telecommunications antenna includes a telescoping antenna portion for substantially receiving an electromagnetic signal. The telescoping portion is attached by an antenna mast for conducting the electromagnetic signal. A dielectric spacer and an inductor are in electrical contact with the antenna mast. An RF connector is in electrical contact with the dielectric spacer, opposite the antenna mast, so as to form a capacitor. The RF connector is also in electrical contact with the inductor so that the capacitor and the inductor form an LC circuit with values selected to provide a predetermined impedance match with the remainder of the antenna.</p> 		

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## ANTENNA FOR A RADIO TELECOMMUNICATIONS DEVICE

Background of the Invention

The present invention is directed to the field  
5 of antennas used for radio telecommunications equipment,  
particularly those used to transmit and receive a digital  
signal, e.g. modems and the like. There has been a  
proliferation in recent years in the field of radio  
telecommunications with items such as pagers along with  
10 cordless and cellular telephones becoming commonplace  
items. Radio modems are also coming into use which  
transmit data using a digitally modulated signal. With  
such devices, it is very important to maintain a clear,  
strong signal which preserves the integrity of the data  
15 transmission.

The various antennas used with existing radio  
modems suffer from a number of disadvantages. Previous  
radio modem antennas typically suffer from low gain,  
resulting in a shorter operating radius and also poor in-  
20 building performance, thus seriously limiting the  
usefulness of the radio modem.

Previous radio modem antennas are also  
sensitive to the presence of a human operator. The human  
body inherently retains a quantity of charge and thus  
25 behaves as a capacitor. When a person moves close to the  
antenna, their inherent capacitance affects the antenna  
current distribution, lowering the gain and detuning the  
antenna circuit. This phenomenon is called "parasitic  
capacitance" and is also caused by the presence of  
30 certain objects (e.g. metallic bodies) and also various  
ground plane conditions.

Previous radio modem antennas are also large  
and unwieldy, thus reducing the portability of the  
device. Also, previous antennas are fixedly mounted,  
35 having no structures to allow for variations in the  
operating angle. In these ways, the antennas of previous  
systems do not provide the reliable and efficient  
operation necessary for the transmission and reception of  
a digital signal.

Summary of the Invention

In view of the difficulties and drawbacks associated with previous antennas, it would be advantageous to provide an antenna which solves the previous problems while providing a more reliable and efficient antenna design.

Therefore, there is a need for an antenna with an increased operating radius.

There is also a need for an antenna with improved in-building performance.

There is also a need for an antenna which is less sensitive to the presence of a human operator or other source of parasitic capacitance.

There is also a need for an antenna which is small and easily stowed.

There is also a need for an antenna with a wide range of directional positionability.

These needs and others are realized by the radio telecommunications antenna of the present invention which includes an antenna portion for substantially receiving an electromagnetic signal. The antenna portion is attached by an antenna mast for conducting the electromagnetic signal. A dielectric spacer and an inductor are in electrical contact with the antenna mast and respectively in parallel with each other. An RF connector is in electrical contact with the dielectric spacer, opposite the antenna mast, so as to form a capacitor. The RF connector is also in electrical contact with the inductor so that the capacitor and the inductor form an LC circuit with values selected to provide a predetermined impedance match with the remainder of the antenna.

As will be appreciated, the invention is capable of other and different embodiments, and its several details are capable of modifications in various respect, all without departing from the invention. Accordingly, the drawings and description are to be regarded as illustrative in nature and not restrictive.

### Brief Description of the Drawings

The embodiments of the invention will now be described by way of example only, with reference to the accompanying figures wherein the members bear like reference numerals and wherein:

Fig. 1 is an exploded view illustrating the components and configuration of an antenna circuit as according to a preferred embodiment of the present invention.

Fig. 2 is a sectional view illustrating the configuration of the assembled antenna circuit as according to a preferred embodiment of the present invention.

### Detailed Description of the Invention

Referring now to the drawings which are for purposes of illustrating only the preferred embodiment of the present invention and not for purposes of limiting the same, the figures show a monopole antenna having an LC impedance-matching circuit. The present antenna is especially suited for transmitting and receiving at 400 to 1000 MHz and can be collapsed down to store within a modem case that is suitable for inserting within a standard PCMCIA (Personal Computer Memory Card Interface Association) slot.

Turning specifically to Figs. 1 and 2, the LC antenna 10 of the present invention includes a telescoping portion 12 for transmitting and receiving the electromagnetic signal. The telescoping portion 12 is preferably about six (6) cm. long in its storage position and can preferably be extended to about 16 cm. long in its fully-extended operating position. The telescoping portion is secured to an antenna mast, preferably a metal hinge 18 with a screw 14 and accompanying washers. The hinge 18 extends upwards through a plastic housing 16 which retains and protects the entire assembled component.

The hinge 18 is in contact with a copper spring 20 which applies sufficient force to maintain electrical contact through the hinge 18 to the telescoping portion 12. The spring 20 is in contact with an inductor 22 and a dielectric spacer 24. The spacer 24 preferably has a square shape with a central hole and retains the inductor 22 therein as a "lumped" element. The inductor 22 and the spacer 24 are in electrical contact with an RF connector 26 which receives the signal conducted through the antenna 10. The RF connector 26 is connected to the radio modem assembly and communicates the signal therethrough. Upon assembly, the base of the assembled antenna 10 is secured with dielectric epoxy 30 which holds the components in place against mechanical disassembly.

The RF connector 26 includes a plurality of posts 28, preferably four. These posts 28 serve to retain the dielectric spacer 24 in a secure interference fit. The RF connector 26 and the metal hinge 18 both have metallized surfaces which thereby define a capacitor with the dielectric spacer 24 and the dielectric epoxy 30. The spacer 24 is made of a glass-filled nylon material having a dielectric constant of about 4. The epoxy 30 is made from a polymer material having a dielectric constant of about 4. These materials provide a capacitor with a desired capacitance.

The capacitor formed by the hinge-spacer-epoxy-connector sandwich is retained with the inductor 22 so as to form an LC circuit which matches the impedance of the antenna

10 to the radio modem. The metallic posts 28 of the RF connector 26 provide additional capacitance to the capacitor. The capacitance can be primarily adjusted by trimming the lengths of the posts 28, which can be  
5 trimmed to tolerances of a couple thousandths of an inch. The capacitance can also be secondarily varied by changing the material of the housing 16, the spacer 24 or the epoxy 30. In this way, the capacitance can be varied to a very precise degree. The inductor 22 is preferably  
10 a small, high permeability component such as Toko LL 1608 - F22NV, which has a constant inductance of 22 nanohenrys.

By varying the capacitance, the impedance of the antenna 10 can thus be adjusted to match the measured  
15 impedance of the modem. For example, for a 50 ohm radio modem, the impedance of the antenna can be tuned to 50 ohm. This impedance matching significantly improves the antenna gain by reducing internal signal reflections in the circuit. In the radiating mode, the present antenna  
20 transmits nearly all the radiant signal, reflecting very little, as compared with previous systems which lose as much as half to reflection, transmitting a signal only half the strength of that generated by the modem. Thus, the present antenna offers a significant improvement in  
25 gain, greatly increasing the effective operating radius and improving in-building performance.

Another benefit of the present invention is that the matching circuit is quite small and compact. This reduces the susceptibility of the antenna to  
30 detuning due to parasitic capacitance. The present antenna can function satisfactorily in close proximity to a body, unlike the antennas used with previous systems.

In addition to the above advantages, the present antenna is small and easily collapsible, allowing  
35 easy storage when not in use. Also, when mounted the antenna can pivot between 0 and 90 degrees off the vertical plane and also rotate through 360 degrees.

As described hereinabove, the present invention solves many problems associated with previous antennas,

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and presents improved efficiency and operability.

However, it will be appreciated that various changes in the details, materials and arrangements of parts which have been herein described and illustrated in order to

- 5 explain the nature of the invention may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.



THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE  
PROPERTY OF PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

- 5           1.   An antenna for a radio telecommunications  
device comprising:  
            an antenna portion for substantially receiving  
an electromagnetic signal;  
            antenna circuit components further comprising:  
10           an antenna mast for attaching to the antenna  
portion and conducting the electromagnetic signal;  
            a dielectric spacer in electrical contact with  
said antenna mast;  
            an inductor in electrical contact with said  
15 antenna mast, and in electrical contact with said  
dielectric spacer; and  
            an RF connector in electrical contact with said  
dielectric spacer, opposite said antenna mast, so as to  
form a capacitor, wherein said RF connector is also in  
20 electrical contact with said inductor so that said  
capacitor and said inductor are connected to form an LC  
circuit.
2.   The antenna of claim 1 wherein the  
25 inductor is received within a hole in the dielectric  
spacer.
3.   The antenna of claim 1 further including a  
spring which applies a mechanical securing force to  
30 retain the dielectric spacer and the inductor in  
electrical contact with the antenna mast and the RF  
connector.
4.   The antenna of claim 1 wherein the RF  
35 connector includes a plurality of posts which secure the  
dielectric spacer and provide additional capacitance to  
the capacitor.
5.   The antenna of claim 4 wherein the posts  
40 are trimmed to desired lengths so as to provide an

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adjustable capacitance.

6. The antenna of claim 5 wherein there are four posts.

5

7. The antenna of claim 6 wherein the values of the inductor and the capacitor are selected so as to provide an antenna circuit with an impedance that matches that of the radio telecommunications device.

10

8. The antenna of claim 1 wherein the values of the inductor and the capacitor are selected so as to provide an antenna circuit with an impedance that matches that of the radio telecommunications device.

15

9. The antenna of claim 1 wherein the antenna portion comprises a telescoping antenna portion which can be varied between minimum and maximum extendible lengths.

20

10. The antenna of claim 9 wherein the extendible length of the telescoping antenna portion is between six and sixteen cm.

11. The antenna of claim 1 wherein the antenna mast is a hinge which permits the antenna to be pivoted between 0 and 90 degrees to the vertical.

25

12. The antenna of claim 1 further comprising a housing for receiving and securing the antenna circuit components into an assembled unit.

30

13. The antenna of claim 12 wherein the antenna circuit components are secured with a dielectric epoxy which provides additional capacitance to the capacitor.

35

14. The antenna of claim 1 wherein the antenna circuit components are secured with a dielectric epoxy which provides additional capacitance to the capacitor.

15. The antenna of claim 12 wherein the assembled unit is pivotable with 360 degrees of rotation.

- 5           16. The antenna of claim 1 wherein the antenna circuit components are compact, thereby reducing the effect of parasitic capacitance.

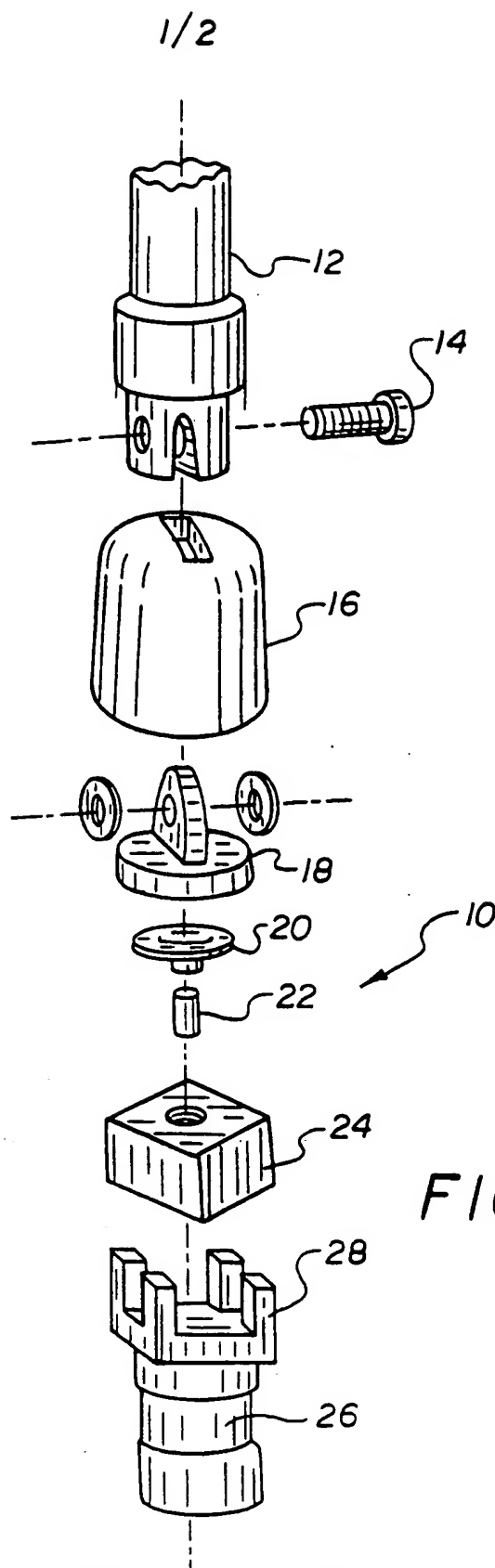


FIG. 1

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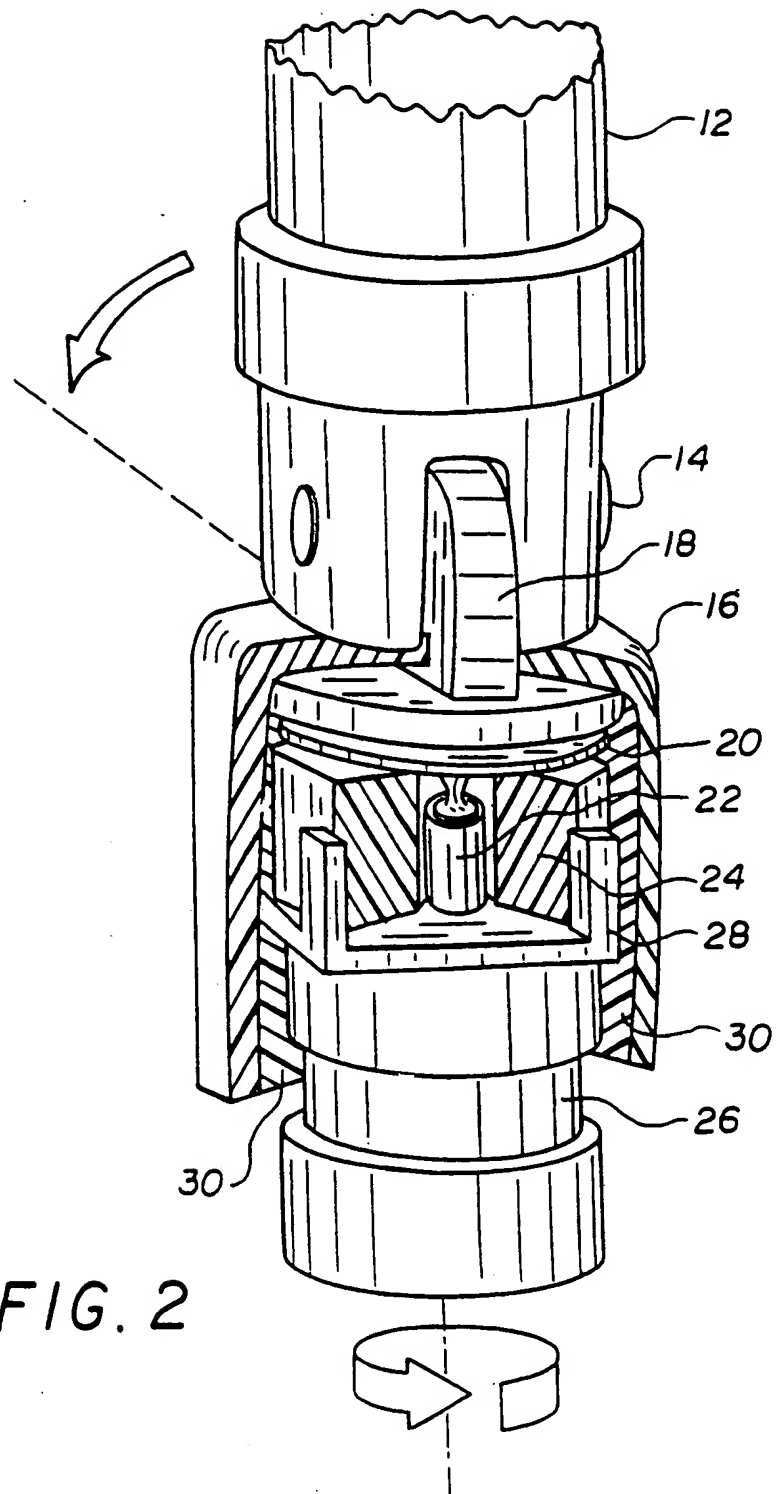


FIG. 2

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# INTERNATIONAL SEARCH REPORT

Original Application No  
PCT/CA 97/00155

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 H01Q1/08 H01Q1/10 H01Q1/22

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 6 H01Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 214 434 A (HSU WAN C) 25 May 1993  see column 1, line 41 - line 43 see column 2, line 63 - column 3, line 2 see column 3, line 12 - line 16 see figures 2,5	1-12,15, 16
Y	--- Microwave Journal, May 1984, p.242, advertisement of Solitron/Microwave, XP002032716 various RF connectors with posts see left-hand column	1-12,15, 16
A	--- US 5 218 370 A (BLAESE HERBERT R) 8 June 1993  see column 4, line 27-34; figure 10 -----	1,2, 10-12, 15,16

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Date of the actual completion of the international search

10 June 1997

Date of mailing of the international search report

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US 5214434 A	25-05-93	NONE	
US 5218370 A	08-06-93	NONE	

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